

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY



(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference 2003B136 | | FOR FURTHER ACTION | | See Form PCT/PEA/416 |
| International application No. PCT/EP2004/014475 | | International filing date (day/month/year) 16.12.2004 | Priority date (day/month/year) 18.12.2003 | |
| International Patent Classification (IPC) or national classification and IPC INV. C07C2/18 C07C2/12 C07C2/70 C07C2/66 | | | | |
| Applicant EXXONMOBIL CHEMICAL PATENTS INC. | | | | |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 1 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> | | | | |
| <p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p> | | | | |
| Date of submission of the demand 17.10.2005 | | Date of completion of this report 18.04.2006 | | |
| Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 | | Authorized officer O'Sullivan, P Telephone No. +31 70 340-4511  | | |

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/014475

Box No. I Basis of the report

1. With regard to the **language**, this report is based on
- ☒ the international application in the language in which it was filed
 - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
 - ☐ international search (under Rules 12.3(a) and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4(a))
 - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a))
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-31 as originally filed

Claims, Numbers

9-22 as originally filed

1-8 received on 17.10.2005 with letter of 17.10.2005

Drawings, Figures

1 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/014475

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------------|
| Novelty (N) | Yes: Claims | 1-22 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 19-20 |
| | No: Claims | 1-18,21-22 |
| Industrial applicability (IA) | Yes: Claims | 1-22 |
| | No: Claims | |

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following documents:

- D1: US-A-3 864 346 (CHILD EDWARD T ET AL) 4 February 1975 (1975-02-04)
- D2: CAVANI F ET AL: "EFFECT OF WATER IN THE PERFORMANCE OF THE SOLID PHOSPHORIC ACID CATALYST FOR ALKYLATION OF BENZENE TO CUMENE AND FOR OLIGOMERIZATION OF PROPENE" APPLIED CATALYSIS A: GENERAL, ELSEVIER SCIENCE, AMSTERDAM, NL, vol. 97, no. 2, 23 April 1993 (1993-04-23), pages 177-196, XP001034799 ISSN: 0926-860X
- D3: US-A-2 681 374 (BETHEA SAM R) 15 June 1954 (1954-06-15)
- D4: US-A-4 018 846 (MAYER IVAN) 19 April 1977 (1977-04-19)
- D5: US-A-5 672 800 (BAES MARLEEN AUGUSTA ET AL) 30 September 1997 (1997-09-30)

Novelty (Art 33(2) PCT)

The subject-matter of claims 1-22 is novel in the sense of Article 33(2) PCT with regard to document D1. D1 discloses (column 1, lines 15-37; column 2, line 65- column 3, line 13) a process for the conversion of an olefin and a paraffin, the water content of the feed being automatically controlled according to an analysis of the composition of the feed. Oligomerisation of olefins or alkylation of aromatic or phenolic compounds is not disclosed in D1.

D2 discusses the effect of water on the performance of solid phosphoric acid in the alkylation of benzene to cumene and for the oligomerisation of propene. It is recognised therein that the water content of the feedstock is an important reaction parameter having an effect on the productivity as well as the purity of the product, ie cumene (see page 178, paragraph 4- page 179, paragraph 1). It is also recognized that the overall life of the catalyst may be improved by an accurate control of the water content (p179, top paragraph). In the tests carried out in D2, the water content of the feed stream was measured with an online moisture analyser from Parametrics (see also application, page

13, line 30, same analyser used). However D2 does not explicitly refer to automatically *controlling* the water content of the feed according to an analysis of the composition of the feed. Present claims 1-22 are therefore considered novel over D2.

The subject-matter of claim 1 is novel in the sense of Article 33(2) PCT with regard to document D3. D3 discloses the polymerisation of olefins employing a phosphoric acid catalyst in which the water content of the hydrocarbon feed is analysed using for example a Foxboro Dynalogue (column 3, lines 3-37). The water content in the feed is controlled in response to the output of the water analyser (column 4, lines 43-64). D3 however does not disclose that the feed passes through a bed of catalyst, rather D3 employs a liquid phosphoric acid catalyst.

Inventive Step (Art 33(3) PCT)

D2 is considered as the closest prior art since it discloses both the oligomerisation and alkylation reactions of the present application and discusses the same issue treated in the present application, namely the effect of feed water content on the performance of the catalyst and the yield of the product. D2 deals with reaction aspects performed on a pilot scale but with the goal being to improve catalyst life/efficiency in industrial scale processes (see for examples, page 178, last line: 'plant operators..'; page 188, line 1: 'industrial point of view'.)

In the tests carried out in D2, the water content of the feed stream was measured with an online moisture analyser from Parametrics (see application, page 13, line 30). The aim of the experimental part of D2 was to plot the role of water (measured by the analyser) on the catalyst performance in terms of activity/selectivity and lifetime. The water content was therefore not kept constant but varied and measured in order to be able to construct plots such as figs 1-3. Suggested operating conditions in D2 are dictated by the type of application; it is recommended that for feeds with higher than recommended water content, some drying pretreatment of the feedstock may be appropriate (page 193). In the conclusions on page 195 of D2 the authors note that the reported data indicate that rather fixed water contents in the feed are necessary to maintain a defined phosphoric acids distribution, that gives rise to the best catalytic performance.

D2 does not appear to deal with feedstocks of varying composition in the experimental part

thereof. However, firstly the present claims are not restricted to stocks having potentially varying reactant composition, and secondly, it is implicit in D2 that the optimal level of water has to be determined experimentally, e.g. by using the methods disclosed in D2. It is clear that even in the present application, should one employ a feed of varying composition, the optimal level of water will still have to be determined for each composition, i.e. using the methods described in D2, in order to be able to 'control' it according to an analysis as required by claim 1.

The difference between D2 and the present application is therefore that D2 does not explicitly suggest using the water analyser of the experimental part of D2 to directly control the water content of the feedstock. The problem underlying the present invention may therefore be formulated as the provision of an improved process for the oligomerisation or alkylation of olefins in which the water content of the feedstock may be controlled in order to achieve the advantages in activity/selectivity and catalyst lifetime mentioned in D2. It is considered that the skilled person wishing to solve said problem would have looked to using the water analyser mentioned on page 180 of D2 in order to control the water content of the feed to within the limits prescribed therein. He also would have used the techniques explicitly disclosed in D1 to determine the optimal water content for a given feed composition, in order to know to what level it should be adjusted after controlling. Present claim 1 can therefore not be considered inventive.

Dependent claims 2-18, 21-22 do not appear to contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step.

Even though Document D5 discloses the importance of water content of the feedstock in the oligomerisation of C₂₋₁₂ alkenes, it is not considered that the skilled person would have combined D5 with D2, which discusses exclusively solid phosphoric acid catalysed reaction in order to arrive at the subject-matter of present claim 19 and 20. Said claims are therefore considered as inventive.

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CLAIMS

1. A process for the conversion of olefins in which the conversion reaction comprises the oligomerisation of olefins or the alkylation of aromatic or phenolic compounds with olefins in a reactor, which comprises continuously passing a feed comprising an olefin and water through a bed of catalyst under conversion conditions to form a conversion product, the water content of the feed being automatically controlled according to an analysis of the composition of the reaction feed.
2. The process according to claim 1 in which the water is introduced into the feed by means of a water wash.
3. The process according to claim 2 in which one or more coalescers are provided downstream of the water wash.
4. The process according to any preceding claim wherein the water content of the feed is automatically controlled in dependence on the results of the analysis by one or more of (a) introducing water into the feed, (b) drying the feed and (c), in the case where a water wash is used, adjusting the temperature of the water wash.
5. The process according to any of the preceding claims wherein an on-line analyser is provided to determine the composition of the feed as it is fed to the reactor.
6. The process according to any of the preceding claims in which the analysis of the reactor feed also includes a measure of the concentration of oxygenated components.
7. The process according to any of the preceding claims wherein the water content of the feed is controlled to be greater during the initial phase of the process than the latter phase of the process.
8. The process according to any of the preceding claims in which the conversion products are separated from unreacted olefins and diluent (if any).